Strategic Performance Monitoring in Higher Education: An Analytic Hierarchy Process Approach

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Abstract. This article explores the application of Analytic Hierarchy Process (AHP) to strategic performance monitoring in university strategy implementation, proposing an integrated approach that enhances clarity, alignment, and managerial effectiveness. The research chapter develops and applies a three-level measurement and aggregation framework for computing an Integrated Strategy Monitoring Index (ISMI) for a university. Results from two-phase AHP show consistent strategic weights. Operational priorities vary by stakeholder, with moderate but acceptable inconsistency (CR≈0.16–0.18), supporting reliable, stratified KPI prioritization.

Keywords: AHP, Strategy Monitoring, MCDA Framework, Multi-Criteria Decision, University Management.

1 Introduction

Traditional performance measurement systems in higher education have many limitations [1] and often rely on fragmented indicators that fail to provide a comprehensive view of strategy implementation. While key performance indicators (KPIs) are widely used, institutions frequently struggle to integrate them into a coherent framework that reflects strategic priorities and supports informed decision-making [2]. This challenge highlights the need for methodologies that enable systematic aggregation, prioritization, and evaluation of multiple performance dimensions [3].

This article explores the application of AHP to strategic performance monitoring in university strategy implementation, proposing an integrated approach that enhances clarity, alignment, and managerial effectiveness.

The article introduces a novel integrated three-level ISMI framework using two-phase AHP for university strategy monitoring. In the next parts of the article the authors present the literature background, construction of the three-level ISMI framework, research design and data collection, AHP-based weighting procedure, aggregation methodology, empirical results, consistency analysis, and concluding implications.

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2 Literature review

Universities increasingly treat strategy not as a static document but as something continuously monitored, evaluated, and adjusted. Strategic monitoring focuses on translating goals into indicators across domains such as teaching, research, infrastructure, and internationalization, then tracking progress [4]. Performance measurement in organizations must capture multiple goals, long causal chains, and intangible social outcomes, while satisfying diverse stakeholders and accountability demands [2].

KPIs in universities span academic outcomes, research productivity, efficiency, and quality dimensions, grouped into academic, research, financial, and stakeholder categories [5]. Common limitations include data reliability, and difficulty capturing qualitative teaching–learning quality and complex educational processes [6].

AHP has been applied in higher education for evaluation, resource allocation, and strategic assessment. It supports group evaluation of research outputs and institution-wide strategic planning [7]. Literature shows dominant use in quality measurement, faculty evaluation, performance assessment, and strategic planning [8].

3 Research method

3.1 Overview of the research design

This study develops a three-level measurement and aggregation framework for computing an Integrated Strategy Monitoring Index (ISMI) for the university. The framework follows the logic of composite indicators, in which a top-level index is derived from a structured hierarchy of lower-level components [9].

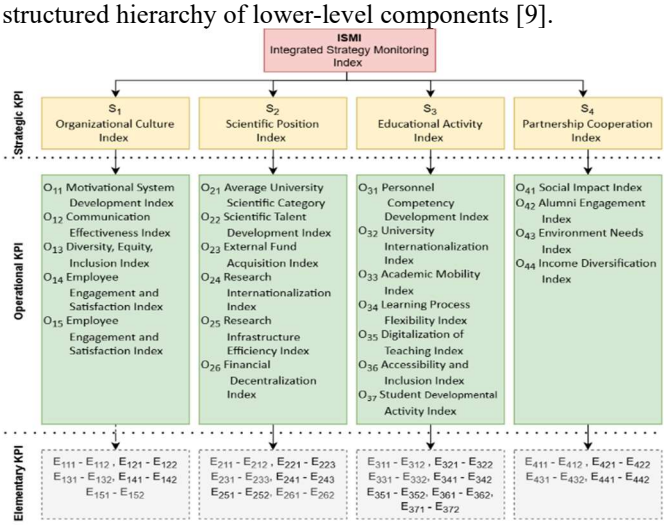

Fig. 1. Research model integrating expert-based AHP weighting of first level hierarchy strategic goals S_1-S_4 with second level operational goals O_{11}-O_{44} (for elementary KPI definition see Appendix 1).

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Fig. 1 shows the hierarchy of the research model. At the first level, the model defines four strategic KPI indices (S_1-S_4). The key strategic dimensions of the university strategy: S_1 (organizational culture), S_2 (scientific position), S_3 (educational activity), and S_4 (partnership cooperation). The second level decomposes each strategic dimension into synthetic operational KPI indices, O_{ij}, where i is the strategic index number and j corresponds to the synthetic index number within each first-level KPI. These indices reflect actionable, monitorable operational goals. The third level operationalizes each synthetic operational index (O_{ij}) as a set of elementary KPIs (E), typically two or three per operational goal. These KPIs are measured from administrative/IT data sources or elicited through stakeholder surveys using Likert-type scales. This design explicitly separates (i) the conceptual structure of the strategy, (ii) the operational monitoring layer, and (iii) the measurement layer, where raw evidence is collected. This improves transparency and traceability in monitoring [10].

Aggregation proceeds bottom-up: elementary KPIs are combined to compute each O_{ij}, operational indices are aggregated into strategic indices S_i, and finally the overall ISMI is computed as a weighted aggregation of $S_1 - S_4$. This enables "drill-down" managerial diagnostics rather than purely descriptive reporting [11].

3.2 Data sources and tools

Expert weighting instrument (AHP survey).
Weights are obtained using a web-based, AHP-aligned pairwise comparison questionnaire. Experts provide comparisons on a symmetric scale ranging. The form was prepared in LimeSurvey, the questionnaire had five questions (one related to strategic goals and four related to operational goals). The link to the questionnaire was sent to 90 experts (66 completed). The instrument is applied at two levels: the strategic level, and the operational level associated with each strategic goal (see **Fig. 1**).

KPI measurement tools and data sources.
Elementary KPIs (E) that feed the operational indices (O_{ij}) are obtained through two channels, as defined in the KPI catalog: administrative/IT data and structured surveys conducted periodically. Administrative data cover indicators that can be measured directly in institutional systems. Survey data cover perception-based or experience-based evidence measured using Likert-type items or threshold questions. All elementary KPIs are harmonized to a common reporting range prior to aggregation through KPI-specific normalization rules.

4 Data collection

The weighting stage was based on an expert survey designed to elicit pairwise comparisons required by the AHP model. The expert panel represented the leading stakeholder roles involved in strategy governance and execution at the University. The questionnaire was distributed online in December 2025 and contained two sections of pairwise

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comparisons corresponding to the two weighted levels of the hierarchy (see Fig. 1.). Research model integrates expert-based AHP weighting of first level hierarchy strategic goals S_1-S_4 with second level operational goals O_{11}-O_{44} (for elementary KPI definition see Appendix 1).

5 Results

5.1 Weights for the strategic KPI level

From the aggregated expert answers, we obtained corresponding consistency measures:

$$\lambda_{max} = 4.023, \quad CI = 0.008, \quad CR = 0.008 \tag{1}$$

which indicate good coherence of expert judgments ($CR \ll 0.10$). The resulting consensus matrix $\overline{A}$ for strategic KPIs is

$$\overline{\mathbf{A}} = \begin{bmatrix} 1 & 0.495 & 0.961 & 1.159 \\ 2.019 & 1 & 2.453 & 2.595 \\ 1.041 & 0.408 & 1 & 1.651 \\ 0.863 & 0.385 & 0.606 & 1 \end{bmatrix}. \tag{2}$$

The eigenvector method of matrix $\overline{\boldsymbol{A}}$ yields the normalized weight vector for strategic KPIs:

$$w_S = (0.198, 0.436, 0.211, 0.154). \tag{3}$$

5.2 Weights for the operational KPI level

Table 2. reports the AHP consistency diagnostics λ_{max}, CI, and CR for the operational-level comparisons within each strategic dimension ($S_1 - S_4$)..

Table 1. The AHP weights with SEM for operational KPIs for different respondent groups.

Strategic KPI	Operational KPI	AHP Weights for respondent groups				
		All (n=66)	Research (n=42)	Administrative (n=13)	Educational (n=8)	Student (n=2)
S_1	O_{11}	0.228 ± 0.017	0.223 ± 0.020	0.228 ± 0.047	0.248 ± 0.044	0.335 ± 0.086
	O_{12}	0.210 ± 0.017	0.198 ± 0.021	0.244 ± 0.047	0.198 ± 0.040	0.247 ± 0.054
	O_{13}	0.086 ± 0.008	0.088 ± 0.012	0.065 ± 0.014	0.114 ± 0.022	0.068 ± 0.034
	O_{14}	0.247 ± 0.014	0.247 ± 0.018	0.235 ± 0.037	0.263 ± 0.035	0.237 ± 0.128
	O_{15}	0.228 ± 0.019	0.244 ± 0.025	0.229 ± 0.038	0.178 ± 0.051	0.114 ± 0.023

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Strategic KPI	Operational KPI	AHP Weights for respondent groups				
		All (n=66)	Research (n=42)	Administrative (n=13)	Educational (n=8)	Student (n=2)
S_2	O_{21}	0.213 ± 0.018	0.219 ± 0.024	0.209 ± 0.038	0.207 ± 0.048	0.104 ± 0.044
	O_{22}	0.154 ± 0.016	0.138 ± 0.017	0.259 ± 0.049	0.100 ± 0.031	0.063 ± 0.037
	O_{23}	0.179 ± 0.009	0.172 ± 0.012	0.184 ± 0.018	0.182 ± 0.009	0.232 ± 0.078
	O_{24}	0.175 ± 0.011	0.170 ± 0.013	0.171 ± 0.028	0.170 ± 0.015	0.327 ± 0.034
	O_{25}	0.123 ± 0.009	0.120 ± 0.012	0.109 ± 0.018	0.147 ± 0.025	0.194 ± 0.011
	O_{26}	0.155 ± 0.017	0.181 ± 0.023	0.067 ± 0.016	0.194 ± 0.058	0.080 ± 0.020
S_3	O_{31}	0.158 ± 0.012	0.157 ± 0.016	0.183 ± 0.031	0.117 ± 0.025	0.144 ± 0.086
	O_{32}	0.157 ± 0.012	0.164 ± 0.016	0.140 ± 0.023	0.163 ± 0.037	0.097 ± 0.051
	O_{33}	0.169 ± 0.013	0.173 ± 0.014	0.143 ± 0.034	0.169 ± 0.035	0.287 ± 0.183
	O_{34}	0.137 ± 0.009	0.126 ± 0.011	0.156 ± 0.021	0.162 ± 0.037	0.102 ± 0.083
	O_{35}	0.137 ± 0.008	0.137 ± 0.010	0.149 ± 0.023	0.129 ± 0.012	0.115 ± 0.048
	O_{36}	0.109 ± 0.008	0.112 ± 0.010	0.091 ± 0.014	0.119 ± 0.015	0.116 ± 0.096
	O_{37}	0.133 ± 0.013	0.130 ± 0.016	0.137 ± 0.039	0.140 ± 0.029	0.138 ± 0.094
S_4	O_{41}	0.211 ± 0.013	0.201 ± 0.017	0.180 ± 0.028	0.290 ± 0.026	0.264 ± 0.142
	O_{42}	0.184 ± 0.015	0.190 ± 0.019	0.178 ± 0.033	0.172 ± 0.025	0.189 ± 0.137
	O_{43}	0.274 ± 0.019	0.289 ± 0.026	0.255 ± 0.045	0.245 ± 0.046	0.181 ± 0.010
	O_{44}	0.331 ± 0.024	0.319 ± 0.028	0.387 ± 0.068	0.292 ± 0.047	0.366 ± 0.269

In classical AHP, the commonly used rule-of-thumb is $CR \leq 0.10$, which indicates that pairwise judgements are sufficiently transitive and logically coherent (e.g., if $A > B$ and $B > C$, then $A > C$). In our survey-based setting, the observed group-average CR values are generally above this strict threshold. For the full sample, CR ranges from 0.161 to 0.177 across the four strategic blocks (S_1: 0.169, S_2: 0.172, S_3: 0.161, S_4: 0.177), indicating moderate inconsistency in operational-level judgements.

Table 2. The AHP consistency measures for operational KPIs[1].

Strategic KPI	Operational KPI	Respondent group	No. of respondents	λ_{max}	CI	CR

[1] In the table with consistency measures, groups with size n < 3 (Student, Other) were omitted due to the low representativeness of the statistical mean.

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S1	O_{11}-O_{15}	All	66	5.756	0.189	0.169
		Research	42	5.822	0.206	0.184
		Administrative	13	5.686	0.171	0.153
		Educational	8	5.458	0.115	0.102
S2	O_{21}-O_{26}	All	66	7.064	0.213	0.172
		Research	42	7.051	0.210	0.170
		Administrative	13	7.353	0.271	0.218
		Educational	8	6.610	0.122	0.098
S3	O_{31}-O_{37}	All	66	8.272	0.212	0.161
		Research	42	8.197	0.200	0.151
		Administrative	13	8.613	0.269	0.204
		Educational	8	7.868	0.145	0.110
S4	O_{41}-O_{44}	All	66	4.478	0.159	0.177
		Research	42	4.544	0.181	0.201
		Administrative	13	4.434	0.145	0.161
		Educational	8	4.292	0.097	0.108

Although the strict $CR \leq 0.10$ criterion is exceeded in most cases, such levels are frequently observed in large-sample, online survey AHP applications and can be considered acceptable when the goal is to capture robust priority patterns.

6 Conclusions

The strategic-level weighting indicates that experts prioritize Scientific Position (S_2) most strongly (0.436±0.023), followed by Educational Activity (S_3) (0.211±0.015) and Organizational Culture (S_1) (0.198±0.022), with Partnership Cooperation (S_4) receiving the lowest weight (0.154±0.016).

The researchers show the strongest polarization, clearly prioritizing scientific position over other goals. The education group gives highest priority to educational activity. Administration is balanced, emphasizing both organizational culture and science.

At the operational level, priorities concentrate on a small subset of levers within each strategic area—e.g., for S_4 the largest weight is assigned to Income Diversification (O_{44}) (0.331±0.024), while in S_1 the highest operational weight is Employee Engagement and Satisfaction (O_{14}) (0.247±0.014).

Consistency diagnostics for operational comparisons show moderate inconsistency (typical $CR \approx 0.16 - 0.18$ across blocks), which is commonly encountered in survey-based AHP with abstract criteria; in comparable applications, thresholds up to $CR \leq 0.2$ are often treated as acceptable for retaining judgements [12].

Limitations include stakeholder variability, moderate inconsistency, and context specificity. Future research should validate ISMI across other institutions.

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Appendix 1 - The elementary indicators definition

Op. KPI	El. KPI	Definition (for strategic and operational goals definition see Figure 1)
Organizational Culture Index (S_1)		
O_{11}	E_{111}	Number of employees covered by the incentive system / Total number of employees
	E_{112}	Number of survey ratings >=4 (scale 1-5) / Number of completed surveys
O_{12}	E_{121}	Number of employees using the newsletter / Number of all employees
	E_{122}	Number of survey ratings >=4 (scale 1-5) / Number of completed surveys

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Op. KPI	El. KPI	Definition (for strategic and operational goals definition see Figure 1)
O_{13}	E_{131}	Min (Number of women in managerial positions, Number of men in managerial positions) / 0.5 x Total number of managerial positions
	E_{132}	Number of fully accessible buildings / Total number of buildings
O_{14}	E_{141}	1 – (Number of people leaving work / Average annual employment)
	E_{142}	Average survey score / Maximum possible score
O_{15}	E_{151}	Number of fully digital processes / Number of admin processes
	E_{152}	Value of completed investments / Planned investment budget at the beginning of the year
Scientific Position Index (S_2)		
O_{21}	E_{211}	Number of disciplines A+ or A / Number of disciplines evaluated
	E_{212}	Number of publications for ≥ 100 points / Total number of publications
O_{22}	E_{221}	Number of employees who have obtained an academic degree or title / Number of planned promotions
	E_{222}	Number of academic teachers from abroad / Total number of teachers
	E_{223}	Number of employed young scientists / Total number of employed
O_{23}	E_{231}	Number of applications with a funding agreement / Number of applications submitted
	E_{232}	Value of funds obtained / Value of applications submitted
	E_{233}	Value of funds obtained in projects / Budget for science
O_{24}	E_{241}	Number of pub. with a co-author with foreign affiliation / Number of all publications
	E_{242}	Number of projects with foreign partners / Total number of projects
	E_{243}	Number of international conferences organized with the participation of university / Number of conferences organized with the participation of university
O_{25}	E_{251}	Number of articles for above 100 p. prepared using equipment / Number of all publications
	E_{252}	Research Services Revenue / Operating Costs
O_{26}	E_{261}	Funds at the disposal of units / General budget
	E_{262}	Non-administrative employees / Number of employees
Educational Activity Index (S_3)		
O_{31}	E_{311}	Number of teachers participating in training / Total number of teachers
	E_{312}	Number of student grades > 5.0 (in: 2.0-6.0 scale)/ Number of all grades
O_{32}	E_{321}	Number of foreign students / Total number of students
	E_{322}	Number of foreign language courses / Total number of courses
O_{33}	E_{331}	Number of students leaving (min. 5 days) / Total number of students
	E_{332}	Number of employees using mobility / Total number of employees
O_{34}	E_{341}	Number of working graduates /Total number of graduates
	E_{342}	Number of subjects in remote, hybrid form / Total number of subjects
O_{35}	E_{351}	Number of subjects on the LMS platform / Number of all subjects
	E_{352}	Number of teaching rooms with projector and Wi-Fi / Number of all teaching rooms
O_{36}	E_{361}	Number of students with disabilities receiving support / Number of students with disabilities
	E_{362}	WCAG -compliant resources / Number of all online resources
O_{37}	E_{371}	Number of students in student clubs and organizations / Total number of students
	E_{372}	Number of students on internships and traineeships / Total number of students
	E_{373}	Number of people pursuing individual study programs / Total number of students
Partners Cooperation Index (S_4)		
O_{41}	E_{411}	Number of active partnership agreements / Number of all signed agreements
	E_{412}	Number of positive responses / Number of all surveys
O_{42}	E_{421}	Number of alumni in the BPA contact database / Number of alumni from the last 5 years
	E_{422}	Number of people with alumni cards participating in events at university / Number of alumni cards
O_{43}	E_{431}	Number of programs consulted with external organizations / Number of all programs
	E_{432}	Number of diploma theses and projects carried out in cooperation with the environment / Number of all theses
O_{44}	E_{441}	Non-subsidy revenues / Value of total revenues
	E_{442}	Commercialization revenue value / Total revenue value

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